CHAPTER 7

SCHEDULING AND PROJECT CONTROL
Schedules are an extremely effective tool for managing construction projects, especially large and complex projects.

• The most important use of schedules is project control: the scheduler compares actual performance with baseline performance and discerns any deviation, analyzes it, and suggests solutions to bring the schedule back on track, if possible.

• There is a difference in attitude between a contractor who is using the schedule because he or she is convinced that it is an effective and powerful tool for project management and contractor who is using the schedule because the owner requires doing so.
Project control comprises the following continuous process:

1- Monitoring work progress.

2- Comparing it with the baseline schedule and budget (what it was supposed to be).

3- Finding any deviations, determining where and how much, and analyzing them to discover the causes.

4- Taking corrective action to bring the project back on schedule and within budget.

*Project monitoring and project tracking are corresponding in meaning with project control.
* Schedule updating is just one part of the project control process. Schedule updating must reflect actual work and involves incorporating approved changes into the baseline schedule.

**What is a baseline schedule?**

* A baseline schedule is a schedule prepared by the contractor, usually before the start of the project, and used for performance comparison. If approved by owner, the baseline schedule usually becomes a part of the contract documents.

* Baseline schedules are prepared on the basis of expectation and previous experiences. Thus, it is advisable to keep an accurate record of previous work to use for future estimates.

**What is an updated schedule?**

* A revised schedule reflecting project information at a given data date regarding completed activities, in progress activities, and change in the logic, cost, and resources and allocated at any level.
What is data date?
project is  The data date is the date as of which all progress on a reported it is also called as- of date and status date .

What kind of information is needed for updating schedules?
1- Past information : what has happened since the last update ?
This information can be divided into past and current categories .

* Past represents information about work that occurred prior to the previous update.

* Current represents information about work that occurred between the last update and this update.

2- Future information : the future category comprises any changes to schedule or schedule items.

Future changes are two types :
A- logic – driven changes
B- user’s changes
Frequency of updating:

*Construction schedules may be updated monthly, biweekly, weekly, or recording to another time interval.

*Project managers must achieve a delicate balance between updates is too long and one is too short.
The former case may yield negative consequences such the following:

* Waiting too long to update a schedule may eliminate the effectiveness of updating as a control tool.

* The amount of work progress that occurred during the period may overwhelm the scheduler.

* Having a too long period may encourage procrastinators to put off corrective measures by using the logic “we will do it later. There is plenty of time!”.
Updating schedules and pay requests:
* In many cases, project updating is tied to payment requests.
* In general, a pay requests is a document submitted by the contractor to the owner, asking for payment for work actually performed (whether finished or not) during the period since the last pay request.

Effect of adding or deleting activities on logic:
* An activity in a schedule is usually like a link in a chain; removing a link may disturb the whole chain if it is not done properly.

For example:
Deleting activity AS520 in the partial network shown in figure will remove any link between activities in each side.
It is strongly recommended that the scheduler review the Logic before making any change by first printing a logic Report showing all predecessors and successors for the Activity be deleted.
Steps for updating a Schedule:

Updating a schedule includes the following steps:

1- The project manager prepares a list of actual progress, changes for individual activities, and all related information.

2- The scheduler feeds the information into the computer scheduling program and updates the schedule.

3- The schedule discusses the new situation with the project manager and make sure that there is no need for additional adjustment.
4- The scheduler prints new reports that show the updated schedule and delivers them to the project manager.

5- The schedule may feedback from different parties.

6- When the next updating cycle is due, the same steps are repeated.
After updating the schedule you can compare the current update with the previous one and summarize what happen.

Here are some criteria for comparison such as added or deleted activities, added or deleted relationships, percent complete, budget, and used resources.

After step 2 is complete negative float values appear on the schedule for certain activities, that means this activity is behind schedule by a number of days equal to the float amount.
Negative float could be one of two reasons:

1. The entire project (primarily the critical path) is behind, the critical path is the longest path with the most negative float or its total float is less than a certain value usually 1.

2. One particular activity is behind its constrained start or finish date.

The project manager must find solution to bring such activities back on schedule and not leave any negative float.
Change in the Critical Path

Some times, the critical path changes after updating, this happen if one of the following occurs:

- An activity on the critical path took less time than originally planned or an activity on the critical path was deleted so the second longest path took over.

- An activity not on the critical path took more time than originally planned so that path took over.

- An activity is added to a near–critical path so it become the longest path.

The project management team must then shift attention to the new critical path and determine why it is become critical.
Contractor – Created Float

When the general contractor perform a faster pace than planned, more float may be added to the remainder of the schedule.

For example: if an activity finishes 2 day ahead of schedule the result may be a float increase for some of the succeeding activities. If the activity was critical the result an earlier finish date for the entire project.

Some people call this type of float: Contractor –Created Float
Project Control

measuring Work Progress:
It is mainly calculating or estimating the percent complete for each activity and for the project.

Methods of determining percent complete for individual activities

There are no correct and incorrect methods; there are only more and less suitable methods for the specific type of activity under consideration.
1- **Units completed**: this method works well for activities with small, identical, repetitive component

Percent complete = units completed / total units

2- **Cost or time ratio**: this method is applies to those activities that are continuous and uniform throughout the project

- If a time ratio: percent complete is calculated by dividing time elapsed by total duration.
- If a cost ratio: percent complete is cost to date by total budget
- Man – hour ratio: actual man – hours consumed divided by total man hours budgeted
3- **start - finish**: this method works best for small activities
- Have not yet started (0%).
- Started but not yet finished (40%).
- Finished (100%).

4- **incremental milestone**: it is more suitable for large and complex or multistage activities. Each stage is assigned a “weight” that is approximately equal to its percentage share of effort in the total activity.

5- **Supervisors opinion**: it is used when no other method can suitably apply, because it doesn’t require actual measurement it has been considered the quickest and dirtiest and most convenient method.
6-weighted or equivalent units: It is used for large and complicated activities that usually comprise several consecutive or overlapping sub activities this method involves the following five steps:

1- Assign a weight to each subactivity so that total weight is 100%.

2. Multiply the weight of each sub activity by the quantity of the total activity. This is "equivalent weight in unit of each subactivity."

Equation: Equivalent MBF = Assigned weight * Total MBF
3. Determine the percent complete for each sub activity by using one of the previously discussed method.

4. Multiply the percent complete for each sub activity by its equivalent weight. The result is “earned quantity“.
   \[
   \text{Earned MBF} = \text{Equivalent MBF} \times \frac{\text{Completed quantity}}{\text{Total Quantity}}
   \]

5. Add earned quantities for all activities and divide by total quantity: this is the percent complete for the total activity “
Method for determining Percent Complete for the Entire Project:

1- **unit completed**: it is units completed / total units
2- **Budget spending**: it is actual budget / total budget
3- **man – hours budget**: actual man hours / total man hours

This is a measure of consumption of a labor resource not a measure of time

4- **workday unit**: it is based on the assumption that the activities have a weight s proportional to their durations

The percent complete for this project is 20/ 39 or 51.3%
<table>
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<tr>
<th>Activity</th>
<th>IPAs</th>
<th>Original duration (days)</th>
<th>Actual durations (days)</th>
<th>Remaining Durations (days)</th>
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<tbody>
<tr>
<td>A</td>
<td>-</td>
<td>7</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>A</td>
<td>12</td>
<td>9</td>
<td>3</td>
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<td>A</td>
<td>6</td>
<td>4</td>
<td>2</td>
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<tr>
<td>D</td>
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<td>0</td>
<td>5</td>
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<tr>
<td>E</td>
<td>D</td>
<td>9</td>
<td>0</td>
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<tr>
<td>Total</td>
<td></td>
<td>39</td>
<td>20</td>
<td>19</td>
</tr>
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</table>
Note that two assumptions underlie this method:

- All activity have the same weight per day
- Weight the activity is distributed linearly

5- duration percent complete:
It is the distance or how far we have gone compared with the total distance

\[
\text{Percent complete} = \frac{\text{actual duration}}{\text{total duration}} = \frac{\text{total duration} - \text{remaining duration}}{\text{total duration}}
\]
6- Base line duration percent complete:

If the project is a head or behind the base line we may interested in measuring the percent complete by using the previous method, but with regard to the base line schedule.

Percent complete = (Data Date–Baseline start date)/ total baseline duration

This equation is for working days.
Discussion for the methods:

- **Unit completed method**: this may work for the percent complete of an activity but it is difficult to apply to the entire project because there is no single unit in common measure.

- **The budget spending and man hours completed method**: They have their proponent, who believes such method are the best way to control a project.

- **The work day unit method is**: generally a good and unbiased method. Its main pitfall is that activities such as procurement or obtaining permits may have much more weight than they deserve.
The duration percent complete and baseline percent complete method are good measure for what they represent – namely the duration of the project. In this case the project is treated as a linear variable there is no consideration to the type of work done per day and they should be used together; one represent what actually happened and the other represent what should have happened.
In reality the project percent complete may not be very important, it can be used for a general idea about how close the project is to ending, and it is not normally to use it for project control or progress payment.

The percent complete of individual activities is more important because it provides the basis for progress payment.